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WORK OF PROF. VOLMER ON STORAGE BATTERIES

This report covers the state of the research at the end of 1944.

I. Preliminary experiments:

1) Concentration

A 4-molar solution of $TiCl_4$ and HCl is extremely viscous. During reduction, the electrode is soon covered with a solid coating of $TiCl_3$. A 3-molar solution of $TiCl_4$ and HCl acts in a similar manner. The precipitate appears in this case only after a degree of reduction of 30% has been reached. Only a 3-molar solution of $TiCl_4$ in 2-molar HCl can be reduced without difficulty.

II. Experiments being conducted at present:

1) Composition of the solutions:

Anode solution: 2 mol. $TiCl_4$, 1 mol. HCl, 2.5 mol. HBr

Cathode solution: 2 mo. $TiCl_4$, 1 mol. HCl, 1.25 mol. HBr

2) Specific conductivity of the solutions

Cathode solution: 64% reduced: 0.234 $ohm^{-1}\ cm^{-1}$

Anode solution: 40% reduced: 0.344 $ohm^{-1}\ cm^{-1}$

3) Electrodes

Coal or graphite was used as electrode material. Graphite is attacked by the bromine solution after longer periods of time, swells, and peels off. P 101 Coal of Siemens-Plania is unsuitable, since it develops hydrogen sulfide with hydrochloric acid and also shows high polarization.

4) Diaphragms

Two porous clay cells, one placed inside the other, serve as diaphragms; the space between the cells is filled with fine sand.

5) Current yields

The current yields also in this case lie between 95 and 85 %.

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III. Long-time experiment No.2

60 cc cathode solution / graphite electrode, current density 0.2 A/ dm^2

70 cc anode solution — coal electrode

Energy yields between 50 and 60 %

Average discharge voltage:0.83 V

The cathode solution was covered with a thin film of paraffin to prevent oxidation by the oxygen of the air. After the first 80 charges, the voltage during the charging process rose steeply, due to contamination of the negative electrode having become impure from organic matter. The electrode was replaced by a new one, and the charging curves became normal again.

Average discharge voltage: 0.72 V

Energy yields: 50 %

Capacity : 1.2 A h

Energy capacity: 0.82 W h or 2 950 Joule

Utilization of the total amount of Ti: 17 %

IV. Experiments with carbon types A, Aa, T, Ta, 1942, 1942a

The polarization during charging is smaller with activated carbons than in those not activated. Material Aa showed the best properties.

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